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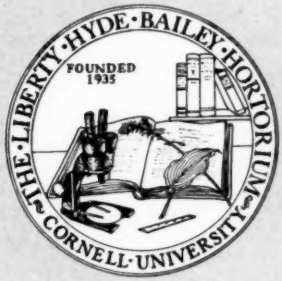

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Pollen Dimorphism in Tripogandra grandiflora

Robert E. Lee[1]

Dimorphic pollen has been described in the genus Armeria (Erdtman 1943) and in Primula (Erdtman 1952). In Armeria, one type with a coarsely reticulate pollen grain is associated with plants that bear flowers containing a corncob-like stigma, while a second type of pollen with a much finer reticulation, even difficult to detect, is found in other plants the flowers of which have a papillose stigma. Similarly, in Primula veris and P. farinosa two types of pollen grains are found in different plants, in this case associated with heterostyly. In both species plants with long styles contain small pollen grains and those with short styles have only large ones. In Tripogandra grandiflora dimorphic pollen is present in each flower.

A cursory examination of the androecium of various members of the Commelinaceae growing in the floriculture greenhouse at Cornell University disclosed interesting variations in the number, type, and arrangement of stamens, as well as the fact that in several species which have stamens in two dissimilar series, the pollen of one series differs in color from that of the other series. This prompted a preliminary examination of several species, but of Tripogandra grandiflora in particular.

Previous workers concerned with the cytology of the Commelinaceae (Wu 1941, Celarier 1955, and Kowley 1959) seem to have neglected the genus Tripogandra, except for Wu, who counted the chromosomes of T. grandiflora from root-tip preparations.

An earlier article on Tripogandra grandiflora in Baileya (Moore 1960) described the two series of dissimilar stamens in the flower of this species and noted that the white anthers borne on short smooth filaments arising opposite the sepals contained fertile pollen, while the yellow-orange anthers borne on long hairy filaments arising opposite the petals carried sterile pollen grains.

Tripogandra grandiflora is apparently self-incompatible as evidenced by failure to obtain seed, either by open or hand pollination. The method used to determine pollen fertility in this study was es-

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sentially that of Bishop (1949), wherein the agar-lactose solution on a cover slip was dusted with pollen and then inverted on a Van Teighem cell in which moistened filter paper had been placed to prevent desiccation. Left at room temperature, the hemispherical pollen grains from the short-filamented white anthers germinated within a few hours. However, the elongate pollen grains from the long-filamented orange-yellow anthers did not show any signs of germination even after 24 hours had elapsed. Repeated trials gave identical results.

The two types of pollen grains from one flower but from different anthers, stained with aceto-orcein, are illustrated in Fig. 22, germination having taken place only in the hemispherical, darkly stained pollen obtained from the short-filamented anthers. Preliminary examination of the two morphologically different types of pollen grains indicated that the hemispherical fertile grains stained readily in aceto-orcein, but that the elongate sterile pollen stained less quickly and less deeply. This difference was similarly accentuated if aceto-carmine was used.

Meiosis in the two different types was studied. Microsporocytes of both series of anthers showed the usual reduction-division process, with the formation of normal microspores. The process occurred more or less simultaneously in both series of anthers. In the early stages after meiosis, immature pollen grains in both types of anthers were indistinguishable from each other.

When the anthers were opened in a drop of stain the day before anthesis, it was comparatively simple to find the first post-meiotic division in process in the hemispherical pollen of the white anthers. At the same time, no post-meiotic divisions were observed in the elongate pollen of the other set of anthers. When the pollen was placed in aceto-carmine soon after dehiscence of the anthers, the white hemispherical grains (fertile) showed an elongated nucleus which stained well, and faint evidence of an ill-defined, almost threadlike reticulum which was probably the second nucleus of the pollen grain. In the yellow elongate pollen (sterile), there was faint evidence of but one ill-defined nucleus. These sterile pollen grains stained very poorly.

The pollen dimorphism is further evidenced in the nature of the cell wall of mature pollen. The fertile grains are distinctly warty, whereas the sterile ones have a heavy sculpturing, more or less reticulate in nature.

It should not be construed that this pollen dimorphism is a generic characteristic of the genus Tripogandra. A plant of T. cumanensis growing in the same greenhouse with the other members of the Commelinaceae was similarly examined. Although there are two different kinds of stamens, both contain pollen grains identical

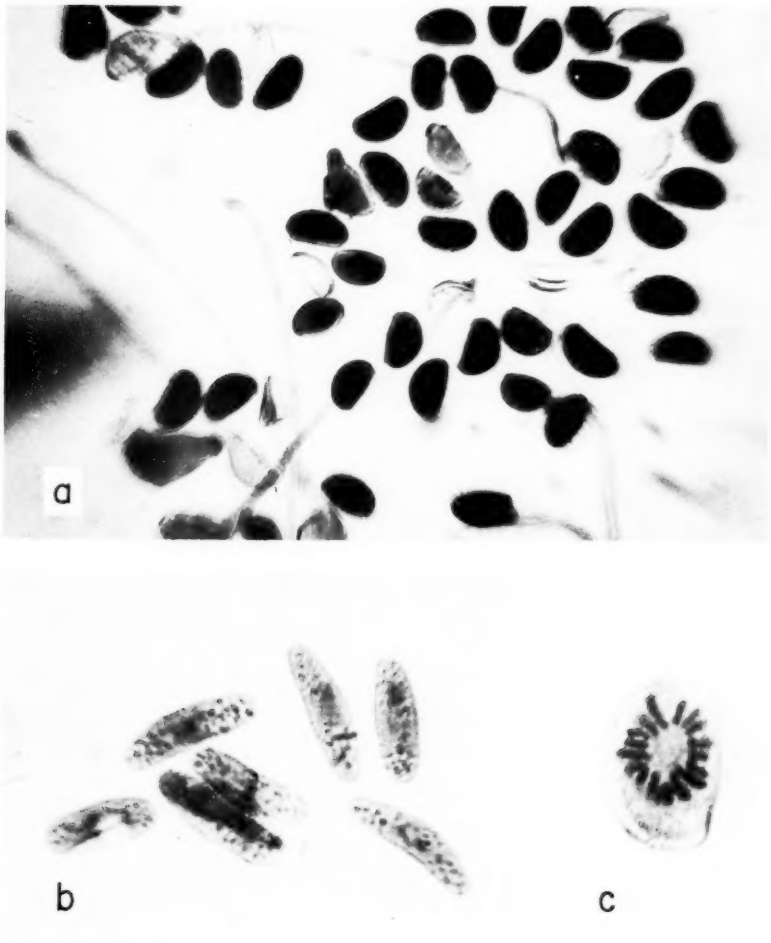

Fig. 22. Tripogandra grandiflora: a, pollen from short-filamented anthers— several have germinated; b, pollen from long-filamented anthers— no germination; c, first post-meiotic division of pollen grain from short-filamented anther. (All greatly magnified.)

in form and size. The pollen grains of both types of anthers are warty on the surface, and all pollen contains two nuclei after the first post-meiotic division. All the pollen stained well, and that from both types of anthers germinated on the agar-lactose medium. Tripogandra cumanensis also appears to be self-compatible, as open-pollinated seeds develop readily.

A more complete investigation of the nature of the androecium, and of the pollen in particular, in the Commelinaceae, especially including some of the less well-known taxa, should make a most interesting project.

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THE GENERA OF CULTIVATED BORAGINACEAE - AN ADDITION

In the key to the cultivated genera of Boraginaceae (Baileya 9: 1-12. 1961), the genus Symphytum was inadvertently omitted. The following pair of choices, 21a, should be inserted after the couplet 21 which occurs on page 9:

21a. Corolla-throat bearing 5 prominent linear-oblong to subulate scales (appendages which are much longer than wide). . . . . Symphytum

21a. Corolla-throat bearing crests (appendages which are about as wide as or wider than long).

Studies in the Cultivated Ericaceae
1. Leucothoe

John Ingram

Erica and Andromeda, two genera of the natural family Ericaceae, clearly demonstrate the evolution of taxonomic thought, and how the concept of generic limits are defined and often modified by taxonomists. Each of these genera was established by Linnaeus in 1753 in his Species Plantarum— Erica with 23 species and Andromeda with 9. Although Erica and Andromeda are not closely related, being members of different tribes, a comparison of their histories after 1753 is interesting because it shows how the concept of a particular genus can change radically or remain essentially unchanged, with critical and careful study. History records an immediate growth for both genera, with Erica, as it is understood today, ultimately reaching about 500 species. Andromeda seemed to be headed for a similar destiny, and during its existence some 200 species have been assigned to it. However, while Erica kept expanding, Andromeda declined until it has been reduced to only two species. The obvious explanation of this circumstance is that Erica began and continued as a more or less homogeneous genus, whereas Andromeda, from its beginning, was a heterogeneous grouping of taxa, and subsequently developed into a catchall for new ericaceous species whose generic affinities were not clearly understood.

Shortly after Linnaeus's death and extending to about 1860 is the period in the history of taxonomy known as the era of the Natural Systems, during which time notable systems of classification were proposed by de Jussieu, de Candolle, and Bentham and Hooker. Among the writers of that period was George Don, who contributed a four-volume work on botany and gardening under the somewhat prolix title, "A general history of the dichlamydeous plants, comprising complete descriptions of the different orders; together with the characters of the genera and species, and an enumeration of the cultivated varieties; their place of growth, time of flowering, mode of culture, and uses in medicine and domestic economy; the scientific names accentuated, their etymologies explained, and the classes and orders illustrated by engravings, and preceded by introductions to the Linnaean and natural systems, and a glossary of the terms used: the whole arranged according to the natural system." Don's

work probably is, however, better known under its alternative but original title, "A General System of Gardening and Botany ..." During the preparation of this formidable work, David Don, George's younger brother, undertook a revision of this difficult family, the Ericaceae, with the expressed purpose of assisting George Don with his labors; his conclusions are presented in a paper entitled "An attempt at a new arrangement of the Ericaceae" (The Edinburgh New Philosophical Journal 17: 150-160, 1834). In his investigation, David Don completely restudied the genera of Ericaceae and decided that both Andromeda and Erica were unnatural, so he erected several new genera in an attempt at creating a more natural arrangement of the taxa which had been included in them. Apparently the erudite Don was interested in Greek mythology, since from the heterogeneous Andromeda he established such genera as Cassandra, Cassiope, Pieris, Zenobia, and Leucothoe; like Andromeda, all are named for characters in Greek literature. It is interesting that these genera are still recognized today. It seems a bit ironic that, although Don treated the genus Erica in a like manner, creating 15 new genera from Erica, his ideas of generic limits within this group were never convincing to later students of the family, and Erica remains today a taxon of 500 or more species.

At various times, the species of Leucothoe have been treated as belonging to as many as six different genera, and again, Leucothoe has been classified as a single genus composed of two subgenera. But as it is usually conceived today, Leucothoe comprises about 50 species distributed into seven sections, growing natively in North and South America and eastern Asia. Some of the species are evergreen and some are deciduous. The two deciduous species of the United States, as late as 1952, have been retained sporadically in the genus Eubotrys Nuttall. It must be pointed out that Eubotrys of Nuttall, published in 1843, cannot be maintained as a generic name since it is illegitimate: Rafinesque had published his superfluous genus Eubotrys in 1837 as a substitute for Muscari Miller because he did not like the adoption of a vulgar name for a generic name. However, the use of Eubotrys as a name for a subgenus or section of Leucothoe is perfectly acceptable.

Leucothoe is typical of the family Ericaceae in its gamopetalous 4- or 5-lobed corollas which vary from cylindric to urceolate, its 10 stamens inserted on a disc, and its 5-celled, many-ovuled ovary. Its woody habit also is typical for the Ericaceae; those species with evergreen leathery leaves are particularly reminiscent of other members of the family. As is typical of the family, leucothoes require a moist peaty soil.

The following key to the eight species of Leucothoe cultivated in the United States is offered, as well as comments on the nomenclature of the most commonly offered species, which has not yet appeared in the trade under its correct name.

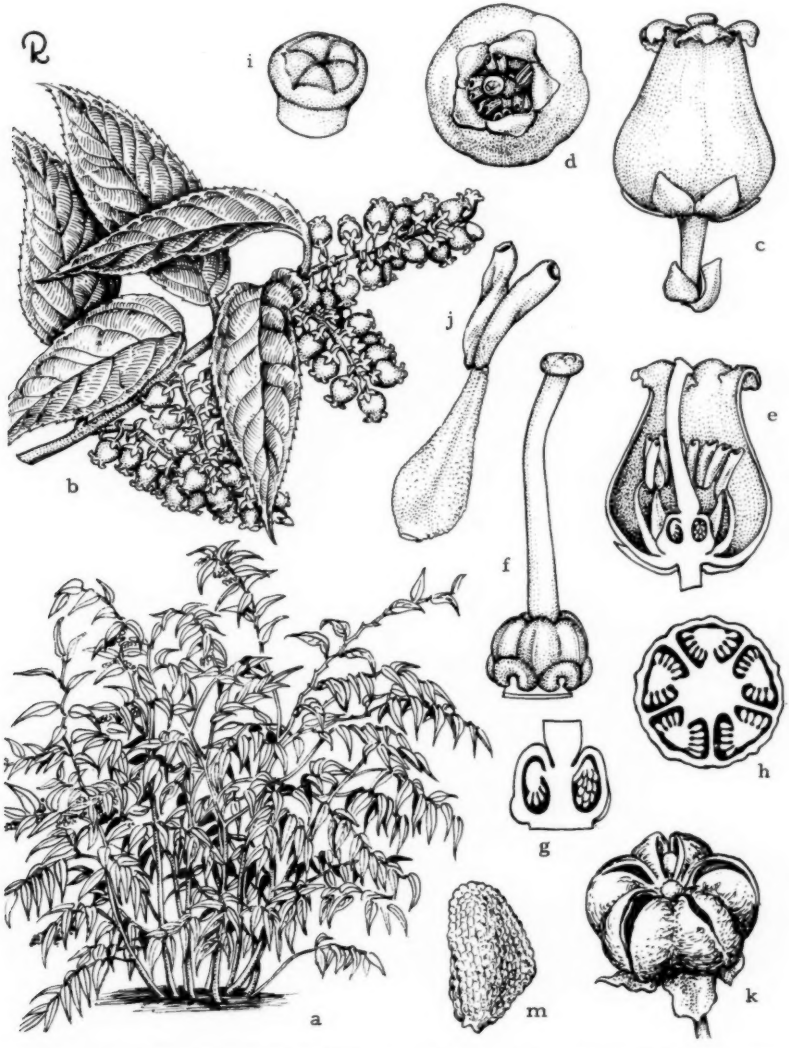


Fig. 23. Leucothoe Fontanesiana: a, habit; b, flowering branch; c, flower x 5; d, flower, face view x 5; e, flower in vertical section x 5; f, pistil x 8; g, ovary in vertical section x 8; h, ovary in cross-section x 13; i, stigma x 16; j, stamen x 13; k, capsule x 6 1/2; m, seed x 16.

Key to the Cultivated Species of Leucothoe

1. Leaves leathery and persistent or sometimes half evergreen; inflorescences symmetrical, either panicles, or dense or loose racemes.
   2. Inflorescence a terminal panicle (fig. 24). . . . . L. Davisiae
   2. Inflorescence an axillary raceme, the racemes rarely both axillary and terminal.
      3. Inflorescence dense, the pedicels only up to twice as long as the calyx at anthesis; corolla 4-7 mm. long.
         4. Leaf-blades mostly abruptly pointed, petiole to 1 cm. long; bracts of the inflorescence ovate to orbicular; sepals broadly ovate and over-lapping (fig. 25). . . . . L. axillaris
         4. Leaf-blades tapering to a point, petioles 1-1.5 cm. long; bracts of the inflorescence lanceolate-acuminate; sepals oblong-ovate, not overlapping (fig. 23). . . . . L. Fontanesiana
      3. Inflorescence loose, the pedicels 5 or more times as long as the calyx at anthesis; corolla 8-15 mm. long.
         5. Inflorescences peduncled; stamens with sigmoid-curved filaments, the anthers not awned (fig. 26B). . . . . L. populifolia
         5. Inflorescences sessile; stamens with straight filaments, the anthers 4-awned (fig. 26A). . . . . L. Keiskei
1. Leaves membranous and deciduous; flowers in terminal one-sided racemes.
   6. Leaves sessile; anthers not awned (fig. 27C). . . . . L. Grayana
   6. Leaves with definite petioles; anthers awned.
      7. Inflorescences straight; anthers each bearing 4 awns; fruit not lobed (fig. 27A). . . . . L. racemosa
      7. Inflorescences recurved; anthers each bearing 2 awns; fruit 5-lobed (fig. 27B). . . . . L. recurva

Leucothoe Davisiae Torrey ex Gray, Proceedings of the American Academy of Arts and Sciences 7: 400. 1868. Sierra laurel. This species is easily identified by its oblong leaves and the usually large inflorescence of white flowers. This inflorescence is essentially a terminal panicle composed of racemes arising from the axils of the upper leaves and end of the stem. It is the only member of the genus from the western United States. It grows in bogs and springy areas in the Sierra Nevadas, and in the Trinity and Siskiyou mountains of California and adjacent Oregon.

Leucothoe axillaris (Lamarck) D. Don, The Edinburgh New Philosophical Journal . . . 17: 159. 1834. [Andromeda axillaris Lamarck, Encyclopédie Méthodique, Botanique 1: 157. 1783; Andromeda Catesbaei Walter, Flora Caroliniana . . . 137. 1788; Leucothoe platyphylla Small, Bulletin of the Torrey Botanical Club 28: 290. 1901.] Like the following species, this is one of the more popular ones in cultivation. It is an evergreen shrub growing to 2 meters and characteristically has elliptic to elliptic-oblong leaves which are usually abruptly pointed. Another distinguishing feature is that its calyx-

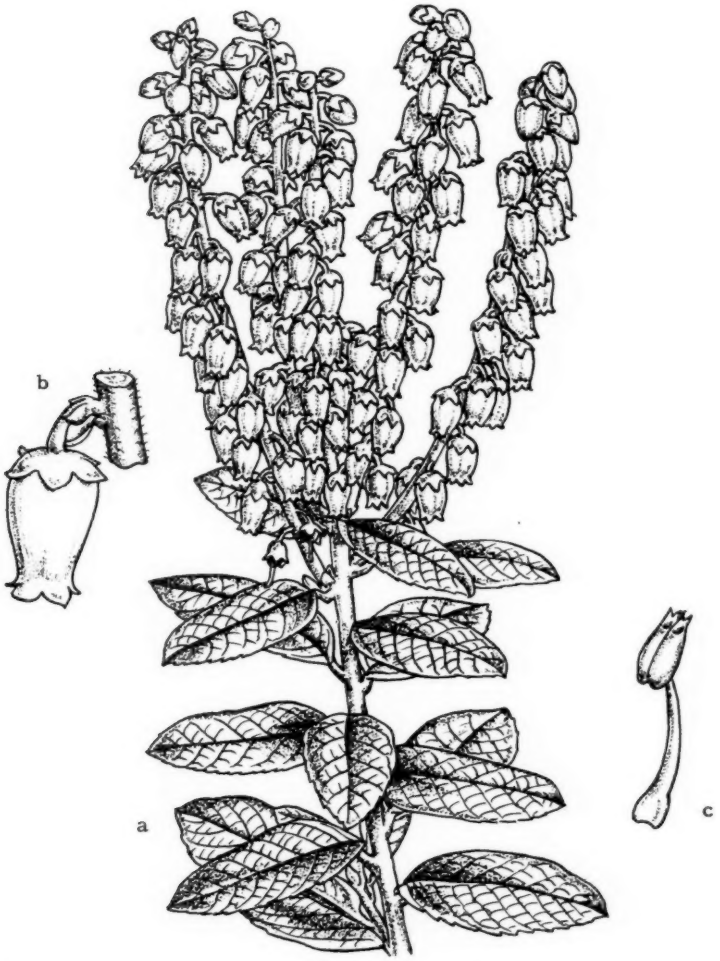


Fig. 24. Leucothoe Davisiae: a, habit; b, flower; c, stamen. Redrawn from Curtis's Botanical Magazine (Third Series) 32: t. 6247. 1876.

lobes overlap, even when the flowers are mature. This species can be found in the wild in moist woods along the Coastal Plain from southeastern Virginia to Florida and Mississippi.

Leucothoe Fontanesiana (Steudel) Sleumer, Botanische Jahrbücher ... [Engler] 78: 438. 1959. [Andromeda Fontanesiana Steudel, Nomenclator Botanicus ... ed. 2, 1: 88. 1840; Leucothoe editorum Fernald & Schubert, Rhodora 50: 218. 1948; Leucothoe Catesbaei as used by Gray, Manual of the botany of the northern United States ... , ed. 2, 252. 1856, not Andromeda Catesbaei Walter.] Doghobble, switch-ivy, drooping leucothoe. This species resembles Leucothoe axillaris, from which it differs in its leaves' tapering to a point, its somewhat shorter petioles, its lanceolate-acuminate bracts, and its non-overlapping sepals. This species has been offered mostly as either Andromeda Catesbaei or Leucothoe Catesbaei, and, as yet, not by its correct name. Great confusion has arisen over this taxon with the result that this species has been well known for over one hundred years but has been correctly named only recently. To begin with, the plant Walter described as Andromeda Catesbaei was not a new species but the same as Andromeda axillaris Lamarck, now properly known as Leucothoe axillaris. The plant Gray was concerned with was a new previously undescribed species, but instead of describing it as new, he confused it with Andromeda Catesbaei and made the new combination Leucothoe Catesbaei

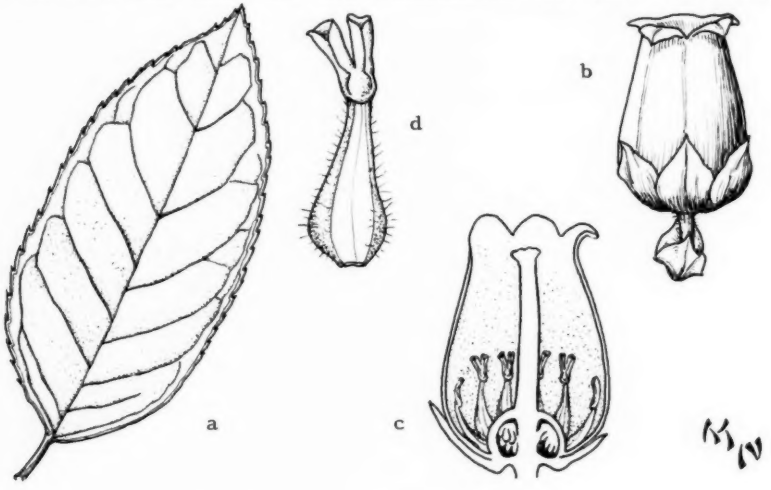


Fig. 25. Leucothoe axillaris: a, leaf x 4/5; b, flower x 5; c, flower in vertical section x 6 1/2; d, stamen x 16.

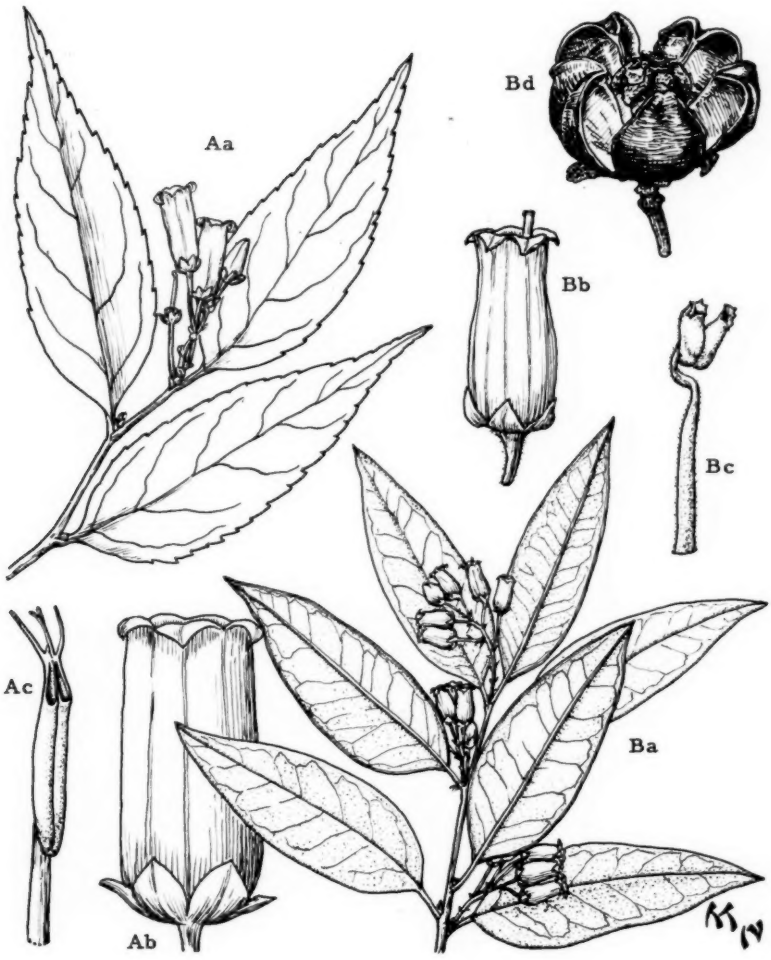


Fig. 26. A, Leucothoe Keiskei: a, tip of flowering branch x 4/5. (Redrawn from Matsumura, Icones Plantarum Koiskavenses 1: t. 34. 1912); b, flower x 3; c, upper portion of stamen x 6. B, Leucothoe populifolia: a, end of flowering branch x 4/5; b, flower x 3; c, stamen x 6; d, capsule x 5.

(Walter) Gray, which added yet another synonym to Leucothoe axillaris, leaving Gray's new species still without a name. Fernald and Schubert recognized and understood this problem when they proposed Leucothoe editorum as a new name for this taxon. However, as they suspected, there was an older epithet which should have been used, and about ten years later Sleumer restudied this complicated problem making the proper transfer which resulted in the correct name for the species. Leucothoe Fontanesiana is native in North America from Virginia to Georgia and Tennessee, where it grows along the mountains in moist wooded areas.

Leucothoe populifolia (Lamarck) Dippel, Handbuch der Laubholzkunde 1: 356, fig. 234. 1889. [Andromeda populifolia Lamarck, Encyclopédie Méthodique, Botanique 1: 159. 1783; Leucothoe acuminata (Aiton) G. Don, A General System of Gardening and Botany ... 3:832. 1834; Andromeda acuminata Aiton, Hortus Kewensis 2: 70 . 1789.] This species is distinctive among the cultivated leucothoes in that the staminal filaments are sigmoid-curved. Its peduncled inflorescences and long-pedicelled flowers readily mark it as distinct from the other members of the genus native in the United States. Its home is in swamps on the Coastal Plain from South Carolina to central Florida.

Leucothoe Keiskei Miquel, Annales Musei Botanici Lugduno-Batavi 1: 32 1863. In many respects Leucothoe Keiskei resembles L. populifolia, especially in its loose inflorescences and long-pedicelled flowers. The staminal filaments are quite straight. This species is distinctive in that it has the largest flowers of the cultivated species. It is a native of Japan.

Leucothoe Grayana Maximowicz, Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg 18: 46. 1872. This native of Japan superficially resembles the following two species which are natives of eastern North America. It differs from them in its almost sessile leaves and its unawned anthers.

Leucothoe racemosa (Linnaeus) Gray, Manual of the botany of the northern United States ... ed. 2, 252. 1856. [Andromeda racemosa Linnaeus, Species Plantarum, ed. 1, 1: 394. 1753; Eubotrys racemosa (Linnaeus) Nuttall, Transactions of the American Philosophical Society, new series 8: 269. 1843.] This species and the following one are well marked by their deciduous leaves, one-sided racemes, and awned anthers. Like many others of the genus, this species inhabits moist areas; it is native from Massachusetts to Florida and Louisiana. In addition to the typical variety, Fernald recognized two others; however, besides the typical variety, only var. elongata (Small) Fernald, Rhodora 41: 554, 1939, is cultivated. This variety differs from the other varieties of the species by its pilose branchlets and ciliate sepals. It is native in southern United States from Georgia and Florida to Louisiana.

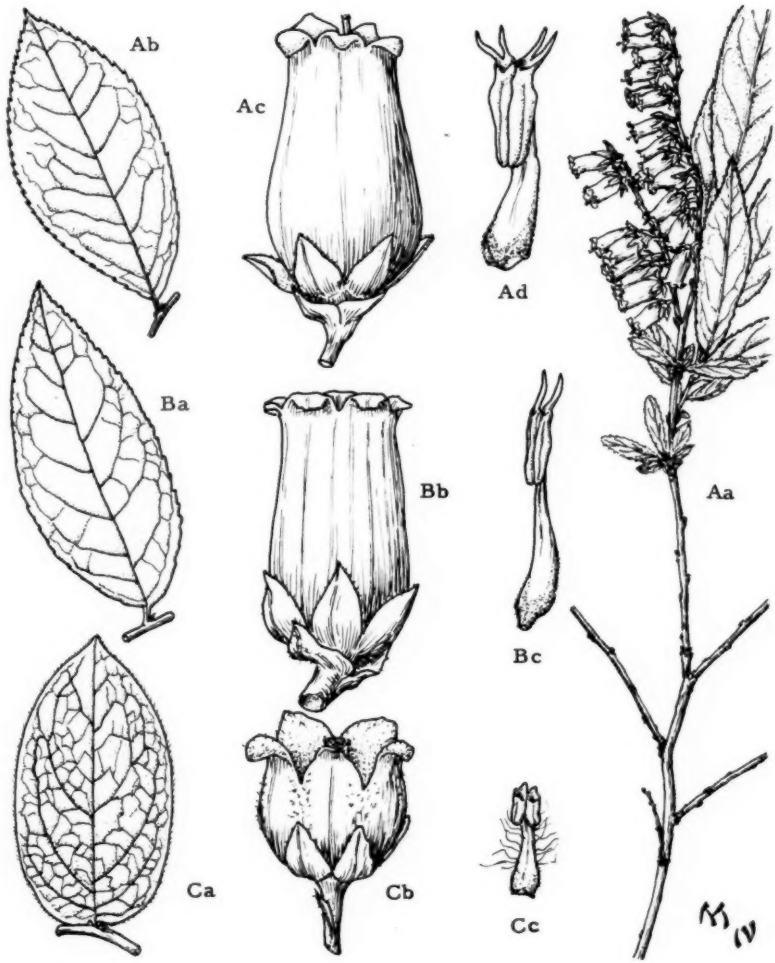


Fig. 27. A, Leucothoe racemosa: a, branch x 4/5; b, leaf x 4/5; c, flower x 5; d, stamen x 8. B, Leucothoe recurva: a, leaf x 4/5; b, flower x 5; c, stamen x 8; c, Leucothoe Grayana: a, leaf x 4/5; b, flower x 5; c, stamen x 8.

Leucothoe recurva (Buckley) Gray, Manual of the botany of the northern United States ... ed. 2, 252. 1856. [Andromeda recurva Buckley, The American Journal of Science and Arts 45: 172. 1843; Eubotrys recurva (Buckley) Britton in Britton and Brown, An Illustrated Flora of the Northern United States, Canada and the British Possessions, ed. 2, 2: 688. 1913.] Redtwig leucothoe. Besides having recurved inflorescences and 2-awned anthers, this species also differs from L. racemosa in having a 5-lobed capsule and flat, winged seeds. It is native from Virginia to Georgia and Alabama, growing in dry areas in the mountains.

Appended below is a finding list of names in Leucothoe as they currently occur in catalogues and horticultural literature; valid names are underscored.

Leucothoe

acuminata (Aiton) G. Don :: L. populifolia
axillaris (Lamarck) D. Don
Catesbaei: the material so offered is L. Fontanesiana, but the name is a synonym of L. axillaris
Davisiae Torrey ex Gray
editorum Fernald & Schubert :: L. Fontanesiana
elongata Small :: L. racemosa var. elongata
Grayana Maximowicz
Keiskei Miquel
platyphylla Small :: L. axillaris
populifolia (Lamarck) Dippel
racemosa (Linnaeus) Gray
    var. elongata (Small) Fernald
recurva (Buckley) Gray

Notes on the Cultivated Compositae
6. The Coneflowers: Dracopis, Echinacea, Ratibida, and Rudbeckia

William J. Dress

Like many another American wildflower, the black-eyed Susan and its relatives are more appreciated as garden subjects in Europe than in their native land, and the Germans especially have developed and named several improved cultivars and races. A few of these improved sorts are becoming fairly well known now in American gardens also, and certain of the species themselves have had occasional advocates in recent popular horticultural journals, though it must be conceded that even the most commonly grown kinds will probably always remain in the ranks of garden flowers of secondary importance. Some other species, available now and then in the trade, cannot aspire even to this degree of usefulness, and find a place under cultivation only in gardens of the botanically minded or in the "wild garden" to which so many less prepossessing plants of all kinds are relegated. Wherever grown, however, they are welcome for their bright, and sometimes brilliant, splashes of color in summer and autumn.

The vernacular name "coneflower" is used for a number of related species of composites having elevated disks that range in shape from hemispherical to cylindric. They are additionally characterized and distinguished from related genera by their alternate leaves and sterile ray-florets which produce no achenes. There has always been and there still is considerable difference of opinion among professional taxonomists as to the proper taxonomic treatment of this group. Differences in taxonomy have resulted in consequent differences in nomenclature, of course, and it would be difficult to find two botanical or horticultural works of even relatively recent date, dealing with more than a very few of the taxa, which are in complete accord taxonomically and nomenclaturally. For the taxonomist, correlation of the names in different treatments is not difficult, but the average horticulturist may find the situation confusing.

The extremely conservative view finds all the species here concerned to be so closely related as to form only a single genus, Rudbeckia. On the other hand, the least conservative treatment countenanced by present-day specialists in the Compositae assigns these same species to four different genera— Rudbeckia, Echinacea,

Ratibida, and Dracopis. Still other workers deem it more satisfactory to recognize only two or three distinct genera. Different treatments of the taxa at a lower level similarly find some authorities recognizing a number of distinct species where others prefer to regard the same taxa as merely varieties of one or only a few species. When careful and experienced workers arrive at different conclusions after having studied essentially the same material, often because the premises upon which such conclusions are based are themselves necessarily a matter of opinion, it is presumptuous to say that one is correct, another not so. The treatment of the cultivated taxa offered here is based largely on published studies of W. M. Sharp (Annals of the Missouri Botanical Garden 22: 51-148. 1935), A. J. Cronquist (in Gleason, New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada 3: 346-352. 1952; also, various papers in Rhodora), and R. E. Perdue, Jr. (Rhodora 59: 293-299. 1957). Together with the appended finding list of names, it should enable anyone with a little patience and skill in the use of a hand lens to identify nearly any coneflower material likely to be found in cultivation in this country. Insofar as possible, the grosser, more easily perceptible characters have been used in the keys, but more technical characters requiring careful observation have had to be resorted to in some places. The paleae (plural of palea), the non-botanist may be reminded, are the small bracts subtending the individual florets in the head; with the aid of a hand lens, their tips are usually readily to be seen protruding among the tiny disk-florets.

Key to the Genera of Cultivated Coneflowers

1. Rays purple or white; paleae stiff and spinescent, extending conspicuously beyond the disk-flowers. . . . . Echinacea

1. Rays yellow, orange, or banded with (or wholly) red-brown; paleae blunt or sharp-pointed but shorter than or barely equaling the disk-flowers.

   2. Leaves (all or some) pinnatifid to pinnately compound.

      3. Achenes flattened, not markedly angled; ray-fls. subtended by paleae. . . . . Ratibida

      3. Achenes 4-angled; ray-fls. not subtended by paleae. . . . . Rudbeckia

   2. Leaves all simple (occasionally deeply 3-lobed).

      4. Annual, glabrous, with broad-based clasping leaves; achenes terete, without pappus. . . . . Dracopis

      4. Perennial or, if annual or biennial, hairy and with cauline leaves tapering to a merely sessile base; achenes 4-angled, the pappus a short crown or lacking. . . . . Rudbeckia

Rudbeckia

The genus Rudbeckia was included by Linnaeus in his Species Plantarum of 1753 and so is the oldest recognized generic name for

Fig. 28. Rudbeckia triloba: a, upper portion of plant x 1/4; b, lower cauline leaf x 1/4; c, heads x 4/5; d, head in vertical section x 1 3/5; e, ray-floret x 1 3/5; f, disk-floret with subtending palea x 6 1/2; g, palea x 6 1/2; h, upper portion of style x 9 1/2; i, two anthers x 22; j, achene x 8.

any of the coneflowers. Of the five species listed there, three— R. laciniata, R. triloba, and R. hirta— are still retained in Rudbeckia, while R. purpurea is placed in Echinacea by those who recognize that genus, and R. oppositifolia has been removed as a Heliopsis. The other three genera accounted for in the present article— Echinacea, Ratibida, and Dracopis— were all founded later on species that had originally been described as species of Rudbeckia.

Key to the Cultivated Species of Rudbeckia

1. Heads without rays. . . . . Rudbeckia occidentalis
1. Heads with rays.
   2. Leaves all simple, entire to toothed but not lobed.
      3. Stems and leaves glabrous.
         4. Leaves shining green, the upper cauline ones tapering gradually to a sessile base. . . . . Rudbeckia nitida
         4. Leaves glaucous, the upper cauline ones broad at the base, clasping.
            5. Plant to 1 m. high; middle cauline leaves narrow-elliptic to ovate-lanceolate; rays spreading. . R. californica var. glauca
            5. Plant to 1-3 m. high; middle cauline leaves broadly ovate; rays drooping. . . . . Rudbeckia maxima
      3. Stems and leaves variously hairy.
         6. Plant perennial, with thick or slender rhizomes; paleae obtuse or acute; style-tips blunt; achenes with pappus of a short crown.
            7. Palea-tips glabrous on the surface though often with ciliate margin; lobes of disk-fls. erect. . . . . Rudbeckia fulgida
               8. Basal lvs. narrowly lanceolate to oblanceolate, the blades 1/3 as broad as long; paleae ciliate at the apex-margin. . . . . R. fulgida var. fulgida
               8. Basal lvs. broadly elliptic to ovate, 1/2 to 2/3 as broad as long; paleae (except sometimes the lowermost ones) non-ciliate at the apex-margin.
                  9. Cauline lvs. hardly reduced in length up the stem, those at the lowest branch about as large as the lower lvs.
                     10. Basal lvs. coarsely crenate or serrate, cauline lvs. with small sharp widely spaced teeth. . . . . R. fulgida var. Deamii
                     10. Basal lvs. entire or obscurely crenate, cauline lvs. coarsely serrate or lacerate. . . . . R. fulgida var. speciosa
                  9. Cauline lvs. diminishing in length gradually up the stem, the uppermost reduced to the size of large bracts. . . . . R. fulgida var. Sullivantii
            7. Paleae-tips densely short-hairy on the surface; lobes of disk-fls. reflexed. . . . . Rudbeckia grandiflora

6. Plant annual or biennial (rarely persisting longer), with compact crown without rhizomes; paleae bristle-tipped; style-tips slender, subulate; achenes lacking pappus. . . . . Rudbeckia hirta

11. Leaves coarsely toothed, the basal ones broadly elliptic to oval with blades about twice as long as wide; cauline lvs. ovate to ovate-lanceolate, the upper sessile ones usually pandurate. . . . . R. hirta var. hirta

11. Leaves entire or finely serrate, the basal ones broadly oblanceolate with blades 3 to 5 times as long as wide; cauline lvs. oblanceolate to broadly linear. . . . . R. hirta var. pulcherrima

2. Leaves, at least some of the largest, deeply lobed or pinnately divided.

12. Disk brown or purplish-brown.

13. Under surface of lvs. rather densely short-hairy, velvety to the touch; paleae much shorter than the disk-fls. and inconspicuous, with finely pubescent blunt tips. . . . . Rudbeckia subtomentosa

13. Undersurface of lvs. with scattered hairs; paleae-tips conspicuous, slender-pointed and glabrous. . Rudbeckia triloba

12. Disk greenish-yellow; leaves thinly hairy or glabrous below, nearly glabrous on upper surface. . . . . Rudbeckia laciniata

Rudbeckia californica Gray is a rather coarse perennial with leafy, stiff, erect stems to 15 or more dm. high bearing 1 to 3 heads on long peduncles. The heads are rather large, with medium yellow rays and a greenish yellow disk that with age becomes conic-columnar and 2 to 5 cm. high. The leaves are generally broadly lanceolate or oblanceolate, hairy on the under surface, less so or glabrous above; the lower ones are petioled and somewhat toothed, the upper sessile and entire. The California coneflower is native to moist meadows of the Sierra Nevada of California; it is probably more suitable for naturalizing than for the cultivated formal garden. Variety glauca Blake, sometimes cultivated also, has glabrous glaucous leaves and comes from the forests of the northern California-southern Oregon coast.

Rudbeckia fulgida Aiton is a complex and variable species, now recognized as being made up of a number of more or less distinct varieties. Nearly all of these have been regarded and named as separate species at one time or another; the synonymy is also crowded with names of variations which have been recognized by some workers but which, by other more conservative botanists, are not regarded as sufficiently distinct from the relatively few varieties distinguished by Perdue, for instance. Plants of this species are stoloniferous perennials, spreading underground and putting up tufts of rather long-petioled leaves of a lanceolate or broader outline, variously hairy. The cauline leaves vary from rather narrow to broad, according to variety, and become gradually shorter-petioled upward along the stem, with the uppermost sessile. The stems tend to branch in the upper half, bearing a number (in vigorous plants) of

medium-sized heads with bright orange-yellow rays and hemispherical or short-conical dark brown-purple disks. The characters that distinguish the several varieties that are cultivated may be sought in the key. Synonyms of the varieties are given below, though only those likely to be used in catalogues, horticultural literature, and recent comprehensive floras are included.

The typical form of the species, the one known to Aiton when he named it in 1789, is known botanically as R. fulgida var. fulgida. It ranges across the eastern United States from Illinois to New Jersey and south to northern Alabama.

Rudbeckia fulgida var. Deamii (Blake) Perdue was originally known as Rudbeckia Deamii Blake, and has been offered for sale once or twice under the name R. speciosa var. Deamii, though this last combination does not seem ever to have been formally published. It is limited in its natural state to a few counties in Indiana.

Rudbeckia fulgida var. speciosa (Wenderoth) Perdue [R. speciosa Wenderoth] has approximately the same natural range as var. fulgida. In 1830 Loudon scantily described a "Rudbeckia Newmani" in his Hortus Britannicus, and this name or its synonym, R. speciosa var. Newmanii hort., has been used for a fairly commonly grown plant which is to be referred to R. fulgida var. speciosa. Whether or not it is Loudon's R. Newmani would be impossible to say.

Rudbeckia fulgida var. Sullivantii (Boynton & Beadle) Cronquist [R. Sullivantii Boynton & Beadle; R. speciosa Wenderoth var. Sullivantii (Boynton & Beadle) Robinson] is perhaps now the most familiar variety of this species in cultivation; it has rather broad leaves, and the rays are longer (2.5 to 5 cm.) and therefore showier than in most other varieties. A good clump, soon formed by the numerous rhizomes, gives a handsome display of brilliant deep yellow in late summer. In nature, it favors moist ground in the western part of the range of the species. Improved cultivars are now available under the names 'Oriole' and 'Goldsturm', the latter being frequently misspelled, or translated as 'Gold Storm', in American catalogues.

Three other varieties of R. fulgida are distinguished by Perdue, but these are not known to be in general cultivation.

Rudbeckia grandiflora (Sweet) de Candolle is another perennial 0.5 to 1 meter tall, with long-petioled ovate lower leaves and sessile upper ones, and one to a few long-peduncled heads with brown-purple conic disks and yellow rays 3 to 6 cm. long which, rather than spreading, droop after the manner of the rays in Echinacea. Native in the southern Midwest, from Missouri and Oklahoma to Louisiana and Texas.

Rudbeckia hirta Linnaeus. This is another complex series of variations which have been treated by some taxonomists as a group

of related species rather than as a single species comprising a few varieties, as here. This species— in particular, the typical variety known botanically as R. hirta var. hirta— was one of the five species listed under Rudbeckia by Linnaeus in his Species Plantarum of 1753.

Rudbeckia hirta, in the broad sense, is now found throughout the United States from coast to coast, and is familiar to almost everyone as the ubiquitous black- or brown-eyed Susan. It is a hairy biennial or short-lived perennial, though it sometimes behaves, under cultivation at least, as an annual. The stems are usually branched, may reach a meter in height; the leaves are very variable, toothed to nearly entire, the lowermost narrowly to broadly oblanceolate and petioled, the upper linear-lanceolate to ovate and sessile. Most frequently the conic disk is brown-purple and the spreading rays bright orange-yellow, but color-variations are relatively frequent and varied, and have been the basis for both botanical and cultivar names in great number. The element known to Linnaeus and named R. hirta by him is the variety native chiefly to the Appalachian Highlands, from Pennsylvania to Georgia and sparingly north to Maine and west to Illinois, according to Perdue. Technically it is known as var. hirta to distinguish it from other varieties of this same species; names which are here considered synonymous with it include R. monticola Small and R. hirta var. monticola (Small) Fernald. This typical variety has broader, more coarsely toothed leaves than the more wide-spread and much more variable variety pulcherrima Farwell.

Though believed to have been originally native only in the Midwest, R. hirta var. pulcherrima Farwell has now spread or been introduced into nearly every one of the United States and is regarded as something of a weed. Botanical names appearing in the horticultural trade and assignable as synonyms to this variety include R. bicolor Nuttall, R. flava T. V. Moore, and R. serotina Nuttall. This frequently sporting variety has given rise to many strains under cultivation, some of the currently popular and available of which are mentioned here. They are nearly all annuals. 'Herbstwald' includes plants about 6 dm. high with rays variously shaded in orange-yellow, red-brown, bronze, and similar tones. It is often offered here under the English translations 'Autumn Woods' or 'Autumn Forest', or even, by a mistake in spelling and idea, 'Autumn Frost'. 'Autumn Tints' may be the same thing, also. 'Sonnenuntergang' ('Sunset') has golden-yellow rays with a dark brown zone. 'Meine Freude' ('My Joy', 'Monplaisir') and 'Bicolor Superba' are good selections with golden-yellow rays and black disks. 'Goldflamme' ('Gold Flame') produces compact ball-shaped plants about 3 dm. high bearing large heads of golden rays and blackish disks; it is suitable for bedding. 'Kelvedon Star' ('Star of Kelvedon') has single or semidouble heads, again with golden-yellow rays and black

central disk. There are strains with "double flowers" (such strains usually produce some singles and semidoubles also): 'Harmony' is almost a meter high, has dark-tinted rays with golden tips; 'Golden Sunset' is yellow; 'Starlight' varies from light yellow to mahogany-brown. Most spectacular of all is the rather recently introduced tetraploid strain known as 'Gloriosa Daisy' which acts as a true perennial, though it blooms the first year from seed. Plants are about 1 meter tall, rather coarse, and branched, and bear huge heads sometimes 15 cm. or more across, with large brown disks and rays that may be entirely golden-yellow or mahogany-red, or bicolored in various ways. This cultivar is richly handsome and appropriate in coloring when it blooms in late summer and autumn. The very recent 'Gloriosa Double Daisy' is a double-flowered development of the last-named strain, and has fully double to semidouble yellow heads about 10 cm. or more across, showing some interesting variation, from plant to plant, in the form of the rays themselves. 'Spoutnik', which has been listed in a French catalogue as a tetraploid strain, is described in terms that lead one to believe it is another name for the American 'Gloriosa Daisy'.

Rudbeckia laciniata Linnaeus is another of the species named and described in the Species Plantarum. The typical variety is a coarse and vigorous perennial, commonly 2 to 3 meters high, with glabrous, glaucous stems and nearly glabrous pinnate leaves with deeply lobed or divided leaflets. The yellow rays are 3 to 6 cm. long and reflexing, the greenish-yellow disk is at first hemispherical but elongates to become conic-oblong in fruit. Rudbeckia laciniata has a wide natural range, from Quebec to northern Florida, westward to and beyond the Rocky Mountains. In the cultivar 'Soleil d'Or' the rays are broader than in the wild type and make the heads considerably showier. The most familiar form in cultivation is cv. 'Hortensia', the goldenglow of old gardens, in which the disk florets have been converted to rays. Because of its height, weediness, and the frequent inability of its stems to support the heavy "double" heads, it is not so much planted these days. The name 'Gold Ball' or 'Golden Ball' apparently is used for this same form. 'Golden Globe' is said to grow only about 1.5 meters high but to be just as invasive. The relatively recently developed German cv. 'Goldquelle' is essentially a greatly improved goldenglow, reported in Pareys Blumengartnerei (ed. 2) 2: 745, 1960, to be a hybrid between Rudbeckia nitida 'Herbstsonne' and R. laciniata 'Gold Ball'. It is a compact plant, bearing more regular "double" heads on strong stems less than a meter in height, and increases only slowly.

Rudbeckia maxima Nuttall is an extremely bold and coarse perennial with stiff erect stems 1 to 3 meters high. The leaves are glabrous and glaucous, the basal petioled, elliptic, as much as 2.5 dm. long and 1.5 dm. wide, the cauline few, progressively reduced in size and more nearly sessile upward along the stem, the upper-

most clasping. The large solitary or few heads have a large conic disk which elongates with age and becomes conic-cylindric and 4 to 8 cm. long, and drooping yellow rays 2 to 5 cm. long. This is native from Texas and Louisiana north into Missouri.

Rudbeckia nitida Nuttall is a southern species of low pinelands from Georgia and Florida to Texas, and so is not reliably hardy in the North. It is a glabrous perennial to about 1 meter high with leathery ovate to lanceolate leaves and large heads with yellow rays and greenish-yellow conic-cylindric disks. A finer form known as cv. 'Herbstsonne' (Autumn Sun), taller and with larger heads, the rays golden yellow, is known in Germany but evidently not available in this country.

Rudbeckia occidentalis Nuttall, a native of the West from Montana and Wyoming to the Pacific states, is hardly worth growing except as a curiosity in a wild garden. It is a coarse perennial to 2 meters high, with large ovate leaves and heads consisting of a high, thick conic-cylindric purple-brown disk destitute of rays.

Rudbeckia subtomentosa Pursh, on the other hand, is a very worthwhile garden plant. It is a shortly rhizomatous perennial, with 0.5 to 1.5 meter stems clothed in toothed lanceolate to ovate leaves, harsh on the upper surface but velvety-pubescent beneath. The lower leaves are usually deeply divided into three lobes. The stem branches above, carrying several heads of bright yellow rays 2 to 4 cm. long and purple-brown conical disks. The involucre and receptacle are said to be anise-scented, whence comes the common name sweet coneflower. In the wild, R. subtomentosa ranges from Wisconsin south to Texas and Louisiana.

Rudbeckia triloba Linnaeus is another attractive but weedy coneflower, generally behaving as a biennial. The rather stiff stems with their many ascending branches grow 0.5 to 1.5 m. high and bear many smallish short-peduncled heads 3 to 7 cm. across, the disk hemispheric and brown-purple, the rays yellow or yellow with orange bases. The leaves are thinly hairy or nearly glabrous, and toothed; the basal ones are ovate or cordate-ovate, with long petioles, while the cauline are narrower and become sessile on the upper part of stem and branches. Usually some of the larger cauline leaves are three-lobed. Rudbeckia triloba is to be found native or naturalized from southern New England to Minnesota, southward to Oklahoma and Georgia.

Dracopis

The genus Dracopis was established in 1825 by Cassini for the species previously described as Rudbeckia amplexicaulis in 1793 by Vahl. It consists of only this one species, which some contemporary taxonomists prefer to retain in Rudbeckia. However, those who

recognize the other genera, Echinacea and Ratibida, as distinct from Rudbeckia, usually consider Dracopis as meriting recognition also.

Dracopis amplexicaulis (Vahl) Cassini [Rudbeckia amplexicaulis Vahl] is an annual, glabrous and glaucous, with a stem simple in the lower half but branching above, and growing 3 to 8 dm. high. The leaves are all cauline, shallowly toothed or entire, the lower oblanceolate, the upper ovate or broadly lanceolate, and all have clasping bases. The heads have a globose or ovoid brownish disk that gradually becomes broadly columnar and 2 to 3 cm. long, and broad short rays 1 to 3 cm. long, somewhat reflexing, yellow or banded basally with orange or purplish-brown. The southern states, from Georgia to Texas, north into Missouri and Kansas, are its native home.

Echinacea

Though Echinacea is now almost universally accepted as the name for this small genus, some of the less recent botanical and horticultural literature has favored the name Brauneria. The latter was published by N. J. de Necker in 1790, in his Elementa Botanica 1: 17; Echinacea was published in 1794 by Conrad Moench in the Methodus Plantas Horti Botanici et Agri Marburgensis ... describendi, p. 591. Despite its obvious priority, Brauneria was for a long time disregarded by many American botanists because Necker mentioned no species (in our sense of the term) when he published the diagnosis of the genus (though Necker used the term "species naturalis" rather than "genus"), and because some felt that Necker had not adequately distinguished Brauneria in segregating it from Rudbeckia Linnaeus. There has also been an unwillingness in some quarters to accept Necker's names as generic names because, as has been mentioned, he unconventionally and deliberately employed the term "species naturales" for what had previously and have since been called "genera," at the same time using "genera" in the sense of the "families" of botanists conforming to accepted usage. Discussion of such problems has now become academic, however; at the Ninth International Botanical Congress, in Montreal in 1959, the Nomenclature Section voted in effect to consider the names of Necker's "species naturales" illegitimate as generic names. Echinacea, then, as the next oldest name, becomes unquestionably the valid name for this genus when Brauneria is thus automatically disposed of.

Key to the Cultivated Species of Echinacea

1. Leaves ovate-lanceolate to ovate, often toothed. . . . . E. purpurea
1. Leaves linear-lanceolate to lanceolate, the blade long-tapering into the petiole, entire.
   2. Rays reflexed, 4 to 9 cm. long. . . . . E. pallida
   2. Rays spreading, 2 to 4 cm. long. . . . . E. angustifolia

Echinacea angustifolia de Candolle [Brauneria angustifolia (de Candolle) Heller] is a rough-hirsute perennial with one or more simple stems from a common crown, up to 5 or 6 dm. high, each commonly bearing a solitary long-peduncled head, though occasionally the stem may branch above and carry two heads. The leaves are simple, oblong-lanceolate, and entire, with 3 to 5 nearly parallel veins running the length of the blade; the basal and lower cauline leaves are long-petioled, the upper ones sessile. The rose-purple to whitish rays are comparatively short— 2 to 4 cm. long— and spreading, while the disk-florets are brownish-purple. The natural range of this species of the plains extends from Minnesota and Texas in the east to the Dakotas and Saskatchewan in the northwest; it also occurs in Tennessee.

This taxon has recently (in Vascular Plants of the Pacific Northwest 5: 160. 1955) been reduced by Cronquist to the status of a variety of the next-mentioned species— E. pallida var. angustifolia (de Candolle) Cronquist. The characters that distinguish the two taxa are not many nor great, and there is little to choose between considering them distinct species or two varieties of one; my own inclination is to maintain them as separate though closely related species.

Echinacea pallida (Nuttall) Nuttall [Rudbeckia pallida Nuttall; Brauneria pallida (Nuttall) Britton] was discovered and described earlier (1834) than the preceding species. Though very similar to it, E. pallida is a stouter and taller plant (to 9 or 10 dm.), and differs also in having narrow rays which are considerably longer (4 to 9 cm.) and reflexed or pendent. The long, projecting paleae of the disk are usually more slenderly acuminate and also minutely hooked or incurved at the tips, whereas those of E. angustifolia are slightly stouter and straight-tipped; however, I have seen specimens of E. pallida with the paleae of the E. angustifolia type, so this distinction does not always hold true. Echinacea pallida is a prairie plant somewhat more eastern in distribution, from the Midwest southeastward into Louisiana, Alabama, and Georgia; it has also become sparingly naturalized in other eastern states.

Echinacea purpurea (Linnaeus) Moench [Rudbeckia purpurea Linnaeus; Brauneria purpurea (Linnaeus) Britton] is the longest-known member of this genus, having been described as a species of Rudbeckia by Linnaeus in 1753, though it was known to European botanists and described and illustrated by them even earlier, in the late 1690's. In 1794 it was made the basis of a new genus, Echinacea, by Conrad Moench. It is the commonest Echinacea in cultivation, and is a standard garden perennial, whereas the other two species, though cultivated, are more likely to be found only in gardens of those who appreciate the less usual. In the wild, it ranges from Ohio to Georgia and westward to Iowa and Louisiana, on the prairies and in open woodland.

It is a stout, robust, even coarse plant, sometimes reaching 16 or 18 dm. in height, and tending to branch above. The leaves are hirsute, the lowermost ovate or broadly lanceolate, coarsely toothed, and long-petioled; the upper cauline leaves are progressively narrower, more nearly entire and sessile. The heads are large, reaching 15 cm. in diameter in some cultivated forms, with rose-purple rays and a disk of dark red-brown florets, from among which protrude the conspicuous, stiff, pointed, often brilliantly orange-red-tinted paleae. The wild form is considered a rather inferior garden plant by many experienced horticulturists, but there are several improved forms, some of which are believed to have been derived from hybridization with other species. 'The King' is the one most commonly offered, with bright crimson rays of good substance. 'Sombrero', bushier and with larger crimson-purple rays than the wild type, has also been listed. German cultivars with large heads and rays in shades of carmine-red include 'Abendsonne', 'Auslese', and 'Leuchtstern', but these are little-known, if at all, in this country. There are also cultivars with white or greenish-white rays, green disks, and yellow orange-tipped paleae listed under the names 'Alba', 'White Prince', 'White King', and 'White Lustre', which may or may not be different from one another.

Ratibida

The three species of Ratibida included herein as in general cultivation in this country were all originally described as species of Rudbeckia early in the last century. It was Rafinesque who first segregated some of these from Rudbeckia, setting up, in his Flora Ludoviciana (Flora of Louisiana) of 1817, the genus Obelisteca for Rudbeckia pinnata (of Ventenat) and the genus Ratibida for Rudbeckia columnaris of Pursh (=Rudbeckia columnifera Nuttall). Later, in 1819, he coined a different name, Lepachys, for the genus including Rudbeckia pinnata though he retained Ratibida for the other species. When both the species mentioned here are considered congeneric, but distinct from Rudbeckia — the treatment usually accorded them today — the genus must bear one of these three Rafinesquean names. Both Lepachys and Ratibida have been widely used, but Lepachys is obviously a later synonym of Obelisteca, and is therefore illegitimate, since it was superfluous when published. Obelisteca and Ratibida, having been published at the same time, would have equal claim on the basis of priority, but since only the latter was ever taken up by botanists, it must be considered the valid name. (When two or more equally good names are published at the same time for what is later considered to be a single taxon [here, a genus], the first of these to be thereafter adopted in print is considered the valid name.) In 1825 still another generic name was published, based on Rudbeckia pinnata Ventenat — Cassini's Obeliscaria — but since it, too, is a superfluous name for Obelisteca, it is illegitimate. It is mentioned

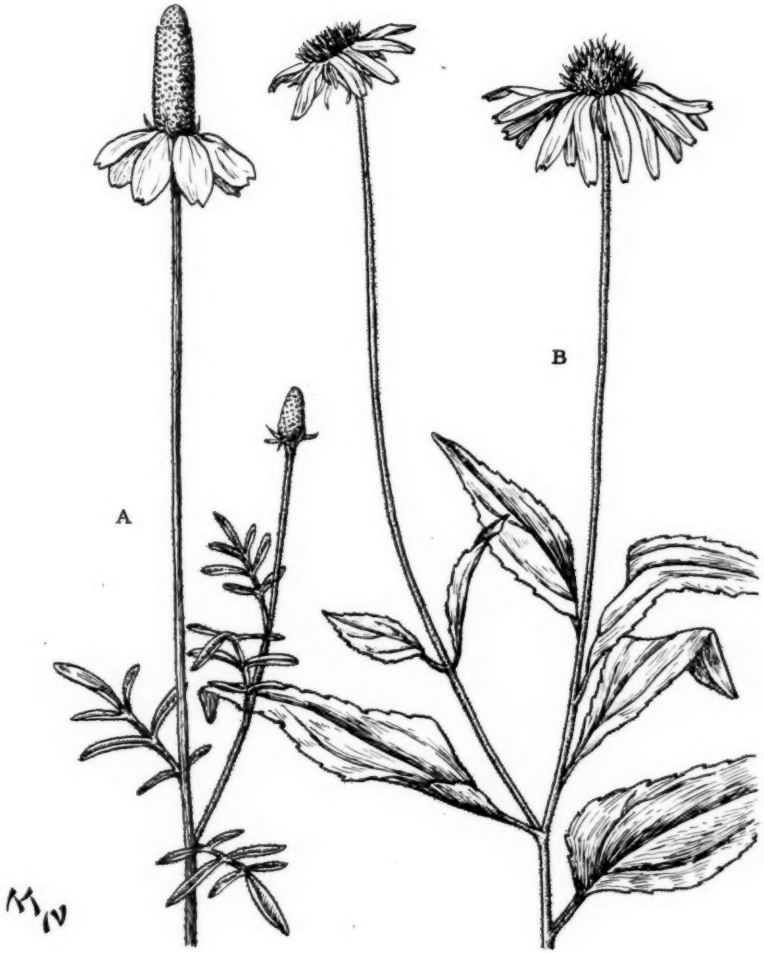


Fig. 29. A, Lepachys columnifera x 3/5. B, Echinacea purpurea x 2/5.

here only because it is still sometimes used for this genus by European botanical gardens, and may also be found in some of the older horticultural literature and catalogues. Though the botanical literature for some time has recognized the validity of Ratibida, the name Lepachys is still incorrectly used, as often as not, in catalogs and seed lists.

Key to the Cultivated Species of Ratibida

1. Rays much longer than the disk, 25 to 60 mm. long; perennial with rhizome-like root system; pappus lacking. . . . . R. pinnata
1. Rays as long as or much shorter than the disk, 3 to 30 mm. long; annual, biennial, or short-lived perennial with tap root; pappus a lacerate crown or of two awnlike setae.
   2. Disk soon becoming cylindric, 10 to 40 or more mm. high; rays 15 to 30 mm. long; pappus of 2 awnlike teeth. . . . . R. columnifera
   2. Disk globose to oblong, 6 to 15 mm. high; rays 3 to 8 mm. long; pappus a short lacerate crown. . . . . R. Tagetes

Ratibida columnifera (Nutt.) Wooton & Standley [Rudbeckia columnifera Nuttall; Lepachys columnifera (Nutt.) Macbride; Rudbeckia columnaris Pursh; Lepachys columnaris (Pursh) Torrey and Gray; Ratibida columnaris (Pursh) D. Don in Sweet; Obeliscaria columnaris (Pursh) de Candolle.] The plethora of synonyms (all of which are not cited here) for this species is accounted for partly by the existence of several superfluous generic names, as explained previously, partly by a difference of opinion among taxonomists as to the validity of the name Rudbeckia columnifera. This name was first published in 1813 in a nursery catalogue of the brothers Fraser of Chelesea (sic), London, England— "A Catalogue of New and Interesting Plants, Collected in Upper Louisiana, and principally on the River Missourie, North America ..." The commentary and description accompanying the name Rudbeckia columnifera reads: "↕ [symbol for 'perennial'] Spontaneous varieties of this plant sometimes occur with bright fulvous flowers, colored like Tagetes patula: the stem is simple, seldom producing more than three flowers, which are of an uncommon length, appearing like a column of flosculi, subtended by 5-8 neutral florets, and a simple calyx [involucre]." It is known that the material offered in the Fraser list had been collected by Nuttall, and that certain of the plant names in it were Nuttall's also, but there is no actual direct evidence that the rest (including our R. columnifera) were names of his devising. For this reason, some botanists refuse to recognize as valid such seemingly anonymously published names as Rudbeckia columnifera, and take up instead the epithet columnaris, published for the same species in 1814 by Pursh. The original description in the Fraser catalogue has also by some been considered inadequate for positive identification of the species offered there.

The arguments for and against the acceptance of Nuttall as author of all the Fraser catalogue names are too complex to be repeated here; several articles on the subject are to be found in Rhodora 57: 290-293, 1955, and 58: 20-22, 23-24, 281-289, 1956, and a reprint of the Fraser catalogue itself is to be found in Pittonia 2: 114-119, 1890, with some comments by E. L. Greene. I find the indirect evidence in support of the Nuttall-authorship thesis convincing enough to take up the catalogue names as Nuttall's, and so am accepting the epithet columnifera as valid. The objection to the description as inadequate has been countered by Fernald in Rhodora 40: 355, 356, 1938: "Certainly this is a far more intelligible diagnosis of a species than was the original characterization of Ratibida for a genus! Wooton & Standley, Macbride and Rydberg have all found it distinctive and, even if it seem to some only a "nomen subnudum" in spite of the three distinctive characters given, it should be noted that the name Rudbeckia columnifera was understood by Pursh when, in 1814, he cited it without qualification as an exact synonym of his newly proposed R. columnaris. The name R. columnaris Pursh, Fl. Am. Sept. 575 (1814), with 'R. columnifera, Fraser catal. 1813' definitely cited as the same, was, consequently, in part an illegitimate (or substitute) name for R. columnifera and to that extent it cannot be maintained!"

Ratibida columnifera is a biennial or short-lived perennial from about 3 to 12 dm. high, branching near the base. The central disk is unusually elongate even for a coneflower; it is cylindrical or columnar and may reach a height of 5 cm. The rays are as long as the columnar disk, or frequently considerably shorter, and in the typical form are bright yellow, though in forma pulcherrima (de Candolle) Fernald the rays are entirely or at least apically purplish brown. This latter form is sometimes offered as Ratibida or Lepachys pulcherrima, or, in years past, as Obeliscaria pulcherrima. The species is found from southwestern Canada to northern Mexico, ranging eastward to Minnesota and Texas.

Ratibida pinnata (Ventenat) Barnhart [Rudbeckia pinnata Ventenat; Lepachys pinnata (Ventenat) Torrey & Gray] is a true perennial, coarser in all its parts than the preceding species, reaching about 12 dm. in height, and branching above. The disk is shorter, being ellipsoid to oblong, perhaps 2 cm. high, and the yellow, drooping rays are much longer — to 5 cm. or more long. This is an eastern species, ranging from Ontario to Georgia and west to Minnesota and Oklahoma.

Ratibida Tagetes (James) Barnhart [Rudbeckia Tagetes James; Lepachys Tagetes (James) Gray] is a much lower, leafy and bushy perennial to 5 dm. high, with only a globose to oblong disk to 1.5 cm. high and very short, relatively inconspicuous yellow or purple-brown rays about 5 mm. long. It is native from Kansas to Colorado and southward to northern Mexico.

Appended here is a finding-list of scientific names to be found in recent horticultural and botanical works, catalogues, and seed lists, and which are applicable to the taxa discussed in this article. As usual, the names accepted in this article are underscored in the list, those rejected are not.

Brauneria Necker :: Echinacea
angustifolia (de Candolle) Heller :: Echinacea angustifolia
pallida (Nuttall) Britton :: Echinacea pallida
purpurea (Linnaeus) Britton :: Echinacea purpurea

Dracopis Cassini
amplexicaulis (Vahl) Cassini

Echinacea Moench
angustifolia de Candolle
pallida (Nuttall) Nuttall
var. angustifolia (de Candolle) Cronquist :: E. angustifolia
purpurea (Linnaeus) Moench

Lepachys Rafinesque :: Ratibida
columnaris (Pursh) Torrey & Gray :: Ratibida columnifera
columnifera (Nuttall) Macbride :: Ratibida columnifera
pulcherrima hort. :: Ratibida columnifera forma pulcherrima
pinnata (Ventenat) Torrey & Gray :: Ratibida pinnata
Tagetes (James) Gray :: Ratibida Tagetes

Obeliscaria Cassini :: Ratibida
columnaris (Pursh) de Candolle :: Ratibida columnifera
pinnata (Ventenat) Cassini :: Ratibida pinnata
pulcherrima de Candolle :: Ratibida columnifera forma pulcherrima

Obelisteca Rafinesque :: Ratibida

Ratibida Rafinesque
columnaris (Pursh) D. Don in Sweet :: Ratibida columnifera
columnifera (Nuttall) Wooton & Standley
forma pulcherrima (de Candolle) Fernald
pinnata (Ventenat) Barnhart
Tagetes (James) Barnhart

Rudbeckia Linnaeus
amplexicaulis Vahl :: Dracopis amplexicaulis
bicolor Nuttall :: Rudbeckia hirta var. pulcherrima
californica Gray
var. glauca Blake
columnaris Pursh :: Ratibida columnifera
columnifera Nuttall :: Ratibida columnifera
Deamii Blake :: Rudbeckia fulgida var. Deamii
flava T. V. Moore :: Rudbeckia hirta var. pulcherrima
fulgida Aiton
var. fulgida
var. Deamii (Blake) Perdue
var. speciosa (Wenderoth) Perdue
var. Sullivantii (Boynton & Beadle) Cronquist
grandiflora (Sweet) de Candolle

hirta Linnaeus
  var. hirta
  var. monticola (Small) Fernald :: Rudbeckia hirta var. hirta
  var. pulcherrima Farwell
laciniata Linnaeus
  var. hortensia Bailey :: Rudbeckia laciniata cv. 'Hortensia'
maxima Nuttall
monticola Small :: Rudbeckia hirta var. hirta
Newmanii hort. :: Rudbeckia fulgida var. speciosa
nitida Nuttall
occidentalis Nuttall
pallida Nuttall :: Echinacea pallida
pinnata Ventenat :: Ratibida pinnata
purpurea Linnaeus :: Echinacea purpurea
serotina Nuttall :: Rudbeckia hirta var. pulcherrima
speciosa Wenderoth :: Rudbeckia fulgida var. speciosa
  var. Deamii hort. :: Rudbeckia fulgida var. Deamii
  var. Newmanii hort. :: Rudbeckia fulgida var. speciosa
  var. Sullivantii (Boynton & Beadle) Robinson :: R. fulgida var. Sullivantii
subtomentosa Pursh
Sullivantii Boynton & Beadle :: Rudbeckia fulgida var. Sullivantii
Tagetes James :: Ratibida Tagetes
triloba Linnaeus

TRADESCANTIA SILLAMONTANA vs. T. PEXATA

When Tradescantia pexata was described in Baileya 8: 98-101, 1960, it was thought that identification with all previously described species had been eliminated. Unfortunately this was not so. Dr. Eizi Matuda of the Instituto de Biología in Mexico has very kindly pointed out that I overlooked an article in Boletin de la Sociadad Botanica de Mexico 18: 1-5, 1955, in which he described Tradescantia sillamontana just after his revisionary study of the Mexican Commelinaceae had been published (Anales del Instituto de Biología 26: 303-432. 1955). Although Tradescantia pexata was described from cultivated material, it was equated with a specimen from Mexico in the Harvard University Herbarium (White & Chatters 30) which now proves to be an isotype of Tradescantia sillamontana.

Tradescantia sillamontana, though based on a different type, is the same as T. pexata and, having priority, is the correct name for the plants which heretofore have been cultivated variously as Cyanotis veldthoutiana, Tradescantia velutina, T. villosa, T. 'White Velvet', T. 'White Gossamer', and, more recently, T. pexata. The name T. pexata should therefore be abandoned by growers of this plant and T. sillamontana substituted. The epithet used by Dr. Matuda is taken from the name of the mountain on which the original material now in the University of Michigan Herbarium was collected - Cerro de la Silla near Monterrey in the State of Nuevo León, Mexico.

H. E. Moore, Jr.

Book Reviews

Palms and Cycads by William Hertrich. 142 pp. Abbey San Encino Press, Pasadena, California. 1951. Second printing, 1960. $5.00.

Cultivated Palms, R. Bruce Ledin, Guest Editor. 189 pp. The American Horticultural Society, 1600 Bladensburg Road N.E., Washington 2, D. C. Paperbound, $3.00; hard covers $4.95. (Published as a special issue of the American Horticultural Magazine, volume 40, January, 1961.)

Palms of the World by James C. McCurrach. 290 pp. Harper & Brothers, New York. 1960. $17.50.

Palms by Desmond Muirhead. 140 pp. Dale Stuart King, Publisher, Six Shooter Canyon, Globe, Arizona. 1961. Light card cover, $1.95; hard cover. $3.00.

To those who live in temperate regions, palms are a symbol of the tropics. As the subtropical parts of the United States have become vacationland or a place of residence for an increasing number of persons each year, palms have played an increasingly important role as subjects for planting in gardens, parks, and along streets in Florida, on the Gulf coast, and in southern California. The variety in habit, size, and form, and the often noble stature of mature trees, lend an exotic note to the landscape, capturing the imagination of visitor and resident alike.

Within the past year, three new books on palms have been published and a fourth reprinted, certainly an expression of growing interest in the family. Each of these books serves a somewhat different purpose.

Cultivated Palms is the result of a happy association between The Palm Society and the American Horticultural Society with added encouragement from the Fairchild Tropical Garden in Miami, Florida. The late Dr. R. Bruce Ledin, who unfortunately did not see the book in print, served as guest editor representing The Palm Society. It was he who assembled the manuscripts, which were further edited and seen through publication by B. Y. Morrison and James P. Harlow of the American Horticultural Society.

The book is designed particularly for and is recommended to the gardener who wishes to know something about the palms as plants and about their culture and uses. It is a successful combination of articles by a variety of contributors, comprising an introductory section on the world of palms, botany and classification, native and cultivated palms, a section on culture including information on preparation, germination and viability of seeds, propagation, fertilization, pruning, insects and diseases, cold tolerance, and a final section on uses inside and outside the home with recommended palms for several sections of the United States.

Characteristics of palms are illustrated with photographs on pages 9-16. Palm portraits on pages 44-128 illustrate the more commonly grown palms and provide material for comparison though there is no attempt to bring out the technical details necessary for definitive identification of palms.

Cultivated Palms is sufficiently broad in scope, accurate in content, and rich in illustration to recommend it to beginner or advanced grower alike.

Palms and Cycads, originally published in 1951 but recently reprinted, is essentially a guide to palms and cycads in the Huntington Botanical Garden at San Marino near Pasadena, California. The author, William Hertrich, now Curator Emeritus, was responsible for the gardens as head gardener, superintendent, and curator from 1905 until his retirement. The palms of the garden are described alphabetically in two groups according to their leaves, whether pinnate or palmate. Detailed botanical descriptions are not provided but photographs illustrate most of those treated. Notes on culture and response to cold in California are incorporated in the text so that the book is useful beyond the confines of the gardens at San Marino.

A few unfortunate errors appear, one of which has been continued by two of the recent writers. The palm illustrated as Chamaedorea graminifolia on page 23 is Chamaedorea elegans (Collinia elegans), while that illustrated as Collinia elegans on the same page is an unidentified species of Chamaedorea. Phoenix Roebelenii is a species distinct from P. Loureirii, which last is not in cultivation. Materials listed as Hyophorbe are generally referred to Mascarena today.

Palms by Muirhead is reproduced by offset, illustrated with both photographs and pen-and-ink sketches, and directed to growers and landscape architects in Arizona and California. Mr. Muirhead is at his best when writing of palms and landscape situations he knows at first hand. Directions for growing, moving, and placing palms are especially applicable to the Southwest. Palms suitable for the region are treated in some detail; others more useful in warmer regions are noted as are some palm-like plants. Mr. Muirhead's sketches liven a section devoted to the landscaping uses of palms as well as many of the palms he writes about.

The book is marred by many misspellings and some incorrect names which either the author or the publisher might have avoided with the exercise of some care. Archontophoenix is correctly spelled on page 68 but appears elsewhere several times as Arcontophoenix; Rhaphis and Raphis but not the correct Rhapis appear on page 28; other errors are scattered through the text. The list of palms on pages 104-108 abounds in errors of orthography and some inaccuracies (such as a height of 200 ft. for Bismarckia nobilis). Mr. Muirhead apparently does not understand the reasons for the confusion surrounding the use of Seaforthia (p. 68) and does not help matters by continuing an unfortunate usage. The palm illustrated on page 49 as Collinia elegans is a species of Chamaedorea but not Chamaedorea elegans.

Palms of the World, a handsome (and expensive) book, will provide the purchaser with an extensive photographic record of palms from Acanthophoenix to Zombia, a record which gives a visual survey of the diversity in habit, foliage, flower, and fruit exhibited by members of this remarkable family. Introductory matter includes notes on nomenclature, economic importance, cultivation, and an illustrated glossary of terms (pp. xiii-xxxxv). Following 270 pages of photographs and text are a list of palm genera taken from Burret and Potztal, lists of palms in several botanic gardens, and a list of references consulted.

If the photographs are sometimes impressive, the text is not. Mr. McCurrach states in the preface (p. ix) that "...I have sought to produce a reliable reference book..." Had he restricted his book to photographs he might, in large part, have succeeded, for the majority of photographs are correctly identified. Notable exceptions are those purporting to be: Chamaedorea geonomaeformis and C. graminifolia on p. 43 which are respectively C. Ernesti-Augusti and C. elegans; Coleospadix oninensis on p. 57 which is Ptychosperma sp.; Deckenia nobilis on p. 76 which is a fan palm (perhaps Livistona sp.); Didymosperma districhum (sic) on pp. 79-80 which is Arenga porphyrocarpa (D. distichum is synonymous with Wallichia disticha which is correctly illustrated on page 260); Iriartea exorrhiza on p. 106 and I. setigera on p. 107 which are Socratea exorrhiza and Iriartella setigera respectively; Mischophloeus sp. on p. 141 which doubtless represents Areca Langloisiana figured as Areca FTG 208 on p. 10; Veitchia Joannis at Fairchild Tropical Garden on p. 255 (left) which is V. Montgomeryana; Yuyba simplicifrons on p. 268 which, if one upholds Yuyba as a distinct genus, is Y. trinitensis.

A reference book, so far as the present reviewer is concerned, is one to which a person may turn for information with the assurance that the information presented is correct. Mr. McCurrach explains in the first line of his preface (p. ix) that "this book has been written by a palm collector in an effort to fill a void in the literature covering the family Palmaceae." Admittedly the void needs filling and it has been filled in some part by this book, yet to find an error (the use of "Palmaceae") in this first sentence does not inspire confidence. The correct names for the family to which the palms belong are Palmae, an irregular form sanctioned by long usage and legitimized by action of international botanical congresses, and Arecaceae, the correct alternative name in the style of most other family names, despite a contrary use of Palmaceae by some writers. Since this book has obviously been written as a reference book for everyone interested in botany and gardening, every attention to accuracy might have been expected. Though the botanist may overlook error, knowing how to find correct information, the non-botanist should be aware that the text very often cannot be relied upon. For this reason, some of the more obvious errors are noted.

In the introductory notes (pp. xiii-xvii) it becomes clear that the author has not digested the principles of nomenclature and taxonomy sufficiently to explain them. Since Linnaeus recognized only one species of Cocos (C. nucifera), it is unfortunate to attribute "larger genera of the early naturalists, such as Linneaus," to him (p. xiii). The unfortunate misconception that plants have "official" names does not help the reader to understand when a name is correct nor why the same plant may be called Veitchia Merrillii by H. E. Moore, Jr. (who considers Adonidia Merrillii insufficiently distinct from other species of Veitchia to warrant a separate genus) and quite as correctly Adonidia Merrillii by someone who has a different concept of genera in the palms.

Apart from errors of fact or typography, perhaps the principal limitation of the text is that the "descriptions" are largely useless for any kind of comparison, and statements are sometimes difficult to comprehend as, page 31, the following comment under Butia: "Many species have been studied, but there is so much variation in plants within a species, that distinguishing characteristics are little more than tendencies. The confusion is increased, no doubt, by cross pollination." Whether we like it or not, the important differences among palms and most other plants are found chiefly in the flowers (dismissed as "...small, greenish and insignificant in appearance") and in the fruits. There is a point beyond which descriptions cannot be simplified if they are to be intelligible and useful -- and if they cannot serve a function, then the photographs should be allowed to speak for themselves. To say that Attalea, Scheelea, and Orbignya are very similar and differ mainly in their staminate flowers, without describing staminate flowers for any of the three (pp. 20, 154, 232), is oversimplification not helpful to the gardener with an inquiring mind or a desire to identify his own plants. Perhaps the differences are not understood by the author himself, for Orbignya Cohune is figured and men-

tioned as Attalea Cohune on pp. xxiv and xv as it is again under Attalea (p. 21), though also figured on page 154 as Orbignya Cohune and mentioned under Orbignya. The generic position of this palm has been known for some years, so today there should be no real confusion. Confusion is continued, however, by lack of careful study of the plants and of the literature.

In the introductory notes (p. xiv) it is stated, "This book describes all 235 of these genera [genera listed by Burret and Potztal], although descriptions of some of the more rare genera are necessarily brief." [Sample: "Parajubaea — a genus of pinnate-leafed palms, native to Brazil and little known elsewhere," an odd description for a genus amply defined by Burret and thus far known with certainty only from Ecuador!] On the following page it is stated that most of the species described or illustrated are being successfully grown in the United States. If growing trees to maturity is accepted as a criterion of success, then the adjective "most" is too strong.

A detailed listing of errors in fact or interpretation would be far too long for inclusion. It may be had on request. Some of the more disturbing errors follow. Bismarckia nobilis "...is said sometimes to reach the incredible height of 200 ft.," though Perrier de la Bathie, who certainly knew the palm, wrote in the posthumously published treatment of palms in Flore de Madagascar, "...de 10-20 m. haut," thus giving the species a height of something over 60 ft. This unfortunate misstatement of 200-foot height also appears in Mr. Muirhead's later book. Ptychosperma and Drymophloeus are certainly not called Balaka (p. 24) even if some species of the latter genus were described originally in Ptychosperma. If no description of Brassiophoenix drymophloeoides is available, it is difficult to know where the name comes from. Mr. McCurrach might look in Notizblatt des Botanischen Gartens und Museums zu Berlin-Dahlem 12: 346-348, 1935, wherein a very lengthy description appears. A search elsewhere would have supplied other "unavailable" descriptions for Dasystachys Deckeriana, Ptychandra glauca. The description given for Caryota Cumingii (p. 37), said to have a single trunk over 40 ft. high, scarcely accords with true C. Cumingii which is a dwarf species with clustered stems. Chelyocarpus (p. 45) is from South not Central America. Chrysalidocarpus, said to be dioecious, is a genus of monoecious palms, a fact which might have been checked in Florida where C. lutescens flowers, or in the Flore de Madagascar.

Martius did not consider it reasonable to consider islands near the coast of Panama as the native home of the coconut as stated in this book. He considered the coconut Asiatic, saying (Historia Naturalis Palmarum 2: 125. 1826), "Patria hujus Palmae videntur orae australiores Indiae orientalis transgangetanae insulaeque Sunda et Moluccae unde per totius orbis terrarum plagam tropicam delata..." Bailey is credited with studying Coleospadix but it was Moore who wrote of it in Gentes Herbarum 8: 299, 1953. All the plants called Coleospadix oninensis in cultivation in this hemisphere and seen by the reviewer are actually a Ptychosperma not yet definitely identified to species. Cryosophila is said to have four species but nine have been described, and C. nana is quite different from C. Warscewiczii. Also, Hedyscepe Canterburyana is quite different from Howeia (p. 98), though stated to be similar.

The correct name for Jubaea spectabilis (p. 109) is J. chilensis and certainly there is no excuse for using Latania Commersonii (p. 112) when Mr. McCurrach reprints illustrations taken from the fascicle of Gentes Herbarum in which Bailey clearly showed that L. borbonica is the correct name. Similar unhappy usages are the continuation of Stevensonia when Phoenicophorium is admitted to be the correct name (p. 238) and of Bacularia (p. 22), the latter "because it was so widely known in England under the Bacularia name" despite a statement that "all Bacularia species are correctly Linospadix." It is unfortunate that on page 141 Mr. McCurrach, using unpublished comments of the reviewer, should "transfer," as it were, Morenia latisecta to Chamaedorea. Morenia corallina is also mentioned and it, according to Dahlgren in Index of American Palms p. 213, is Chamaedorea oblongata not C.

corallina. It is odd to read that plants of Oenocarpus grow in dry and rather elevated forest land after seeing O. multicaulis and O. panamanus in wet to very wet locations at low elevations in Peru and Costa Rica respectively. Residents of Cuba, Mexico, Guatemala, and British Honduras may resent the omission of Paurotis from their floras. Phoenix Loureirii (not lourelei) is not a synonym for P. Roebelenii (p. 168) though the two were long considered the same (see Baileya 1: 25-30, 1953). Nor is it likely that this was "no doubt at one time a hybrid." The species was described from wild specimens obtained along the Mekong River in Laos and breeds true (though it seems likely that in cultivation it may hybridize with other species). Phytelephas, at least as seen in Peru, usually lacks a visible stem. When one is produced, it is erect without aerial roots, contrary to the description on page 173. Phytelephas macrocarpa, originally described from Peru, is listed only from Colombia and Ecuador in this book. Pigafetta elata should be known as Pigafetta filaris. A careful reading of Gentes Herbarum 8: 541-576, 1957, would show that Burret, not Moore, united most species of Malortiea with Reinhardtia. Burret's later reversal is given in Willdenowia 1: 57, 1953, without detailed explanation and it is difficult to understand just what is retained in Reinhardtia from the keys in Willdenowia 1: 353-354, 1956, where the genus is keyed twice. A reading of Furtado's study of Salacca (The Gardens' Bulletin, Singapore 12: 378-403. 1949) would have suggested Salacca Rumphii as probably the correct name for S. Wallichiana. Mature trees of Veitchia Joannis are not to be found at the Fairchild Tropical Garden despite the tree figured which, as earlier noted, is V. Montgomeryana. Bailey's work on Yuyba has been misinterpreted, for he clearly stated that Yuyba simplicifrons and Y. trinitensis are distinct species, contrary to McCurrach's "Yuyba simplicifrons (formerly Y. trinitensis)." More care might have eliminated a number of unfortunate typographic or orthographic errors, the inconsistent use of both Iriartea and Ireartea (the former correct).

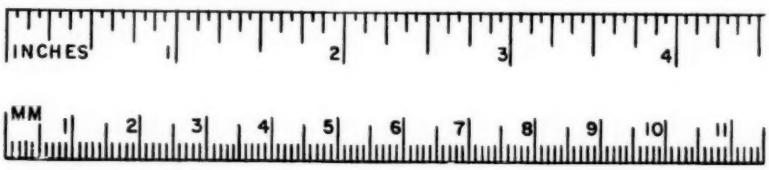
The appendix to this book contains a list of palm genera accepted by Burret and Potztal but for which they surely would not use the adjective "official." To this list may be added Marojejya Humbert, Dahlgrenia Steyermark, Markleya Bondar. Alfonsia should be equated with Corozo, not with Elaeis.

Palms of the World is a book which should be on library shelves for its photographic content. It is to be hoped that users of the text will accept it with caution and not perpetuate the far too many errors it contains.

H. E. Moore, Jr.

ABBREVIATIONS USED IN BAILEYA

ann.	annual	dm.	decimeter	lf.	leaf
bien.	biennial	fl.	flower	lft.	leaflet
br.	branch	fls.	flowers	lvs.	leaves
brt.	branchlet	flt.	floret	mm.	millimeter
caps.	capsule	fr.	fruit	per.	perennial
cl.	clone	ft.	foot	segm.	segment
cm.	centimeter	hort.	horticultural	st.	stem
cv.	cultivar	in.	inch	sts.	stems
diam.	diameter	infl.	inflorescence	var.	variety

METRIC - ENGLISH EQUIVALENTS (approximate)

6 mm. - 1/4 in.	10 cm. - 4 in.	10 mm. - 1 cm.
12 mm. - 1/2 in.	1 dm. - 4 in.	10 cm. - 1 dm.
25 mm. - 1 in.	3 dm. - 1 ft.	10 dm. - 1 meter
2.5 cm. - 1 in.	10 dm. - 1 yd.	
5 cm. - 2 in.	1 m. - 39 in.